Chapter 21
Balloons, Hydraulic Machines and Steam Engines at War and Peace: Jean-Pierre Campmas, a Visionary or an Inefficient Inventor?

Patrice Bret

Charles Gillispie's outstanding contribution to "science and polity in France" carefully analyses the links between science and the modern state in the last decades of the eighteenth century and the first of the nineteenth. Beside major scientists and administrators, he considers several second rank scientists, engineers or inventors who also contributed to modernity, as well as charlatans and others who challenged scientific institutions. In his thorough investigation through the national, scientific and military archives in Paris and Vincennes, he might have come across Jean-Pierre Campmas. That inventor was not directly relevant for Gillispie's investigations. He was nevertheless involved in many of the same areas as Gillispie's protagonists, including ballooning, artillery and other matters that he submitted to French scientific and administrative institutions from the beginning of Louis XVI's reign to the early Napoleonic period.

With few exceptions, historians have paid little heed to Campmas.[1] Despite the abundance of primary sources (printed and manuscript[2]), it is difficult to

[1] Mainly regarding his 1784 balloons (Julien Turgan, *Les ballons*, Paris, Plon, 1851, p. 178; Michael R. Lynn, *Popular Science & public opinion in eighteenth-century France*, Manchester, Manchester University Press, 2006, p. 133; Marie Thébaud-Sorger, *L'Aérostation au temps des Lumières*, Rennes, Presses universitaires de Rennes, 2009, p. 89) and their later military development (P. Bret, "Napoléon et les technologies militaires nouvelles: essai d'analyse à partir des exemples de l'aérostation et de la fusée de guerre", *Revue de l'Institut Napoléon,* n° 148 (1987), 46–60: 49, 54, 58, 59). Also: other military inventions during the Revolution (André Duvignac, *Histoire de l'armée motorisée*, Paris, Imprimerie nationale, 1947, pp. 17–19; P. Bret, *L'État, l'armée, la science. L'invention de la recherche publique en France, 1763–1830*, Rennes, Presses universitaires de Rennes (coll. Carnot), 2002, 124, 126, 127). Strangely enough, the most cited proposal is his unique joint monumental building project in 1801 (Jean Davallon, *Claquemurer, pour ainsi dire, tout l'univers: la mise en exposition*, Paris, Centre Georges Pompidou, 1996, p. 64; Dominique Poulot, *Surveiller et s'instruire: la Révolution française et l'intelligence de l'héritage historique*, Oxford, Voltaire Foundation, 1996, p. 26, and *Une histoire du patrimoine en Occident, XVIII^e^-XX^e^ siècle*, Paris, Presses universitaires de France, 2006, pp. 35–36).

[2] Besides the numerous manuscript sources referred hereafter in the footnotes, we must also cite a file about Campmas which is among those of inventors at the National Archives (AN),

P. Bret (✉)
Centre Alexandre Koyré – Centre de recherches en histoire des sciences et des techniques, Paris, France
e-mail: patrice.bret@yahoo.fr

J.Z. Buchwald (ed.), *A Master of Science History*, Archimedes 30,
DOI 10.1007/978-94-007-2627-7_21, © Springer Science+Business Media B.V. 2012

construct the career and life of such a person, for he is not worth extensive research on his own accord, and my aim here is not to put stress on a second or third rank individual. Nevertheless, Campmas' work and practice are significant for, as an inventor, he is representative of hundreds of others in his time, ones who were prompt to seize fashionable topics and eager for money and glory, usually with little success. The boundaries between fakers and inventors of true genius are not always impermeable. The worst among them might have visionary views scattered amidst their dreams or buried in the most trivial technical details, even when they do not share the rational and science-based approach of experts who assessed their work.

The known biographical data on Jean-Pierre Campmas are less numerous and reliable than the sources regarding his work.[3] Probably born in the mid-1740s, the inventor may have died in 1804, since no further information can be found in later sources. He has often been confused with other personages in the province of Guyenne, in Southwestern France, where that name was rather common in various fields.[4] It would be good to know whether he was a relative of Pierre Jean-Louis Campmas (1756–1821), an attorney and a member of the National Convention (*Convention nationale*).[5] All the same, Jean-Pierre Campmas provides a good example of the various ways in which inventors could ply their trade, both at the end of the Old Regime and during the Revolutionary and early Napoleonic times. In *Science and Polity*, Gillispie pointed to some of them.[6] Like many others, Campmas used the full range of means at inventors' disposal to achieve recognition at the Royal Academy of Sciences or elsewhere,

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which contains material about his "mobile suitable for a great number of hydraulic machines" (AN, F^{14} 3187) and another about his inventions of 1796 to 1802 (F^{12} 2325). Unfortunately, I have not been able to see it.

[3] Even his name has been wrongly read and written, then printed, as "Campenas", "Campinas", "Campmar" and even "Champmas" or "Canas", and his first name turned into Jean-René.

[4] A fountain maker (*fontainier*) at Revel, Pierre Campmas, helped Pierre-Paul Riquet to provide the *Canal du Midi* with water from the Black Mountain (*Montagne noire*) in the 1670s. The physician of the Countess of Artois, Jean-François Campmas, born in Monestiès (Tarn), formerly demonstrator of physics at Montauban, and author of reflexions on childbirth, was sent to the *États généraux* in 1789, but *La France Littéraire* (since 1784, p. 199) wrongly attributed to him a "Machine for rising water with a rope" invented by J.-P. Campmas.

[5] P.J.L. Campmas – also known for his translation of Scipione Breislak's *Institutions géologiques*, from Italian, in 1819 – was born at Blaye (Tarn) and Jean-Pierre was the name of both grandfather, a notary at Carmaux – let us notice that the inventor's signature was followed by a complex flourish very similar to the notary's ones – and his uncle, a priest (E. Appolis, "Un conventionnel régicide" *Revue du Tarn*, 1943–1944, p. 142).

[6] Especially vol. I, Chapter VI, Industry and Invention, pp. 388–478, and vol. II, Chap. VI, Scientists at War, pp. 339–444.

and felt frustrated by lack of credit and funds to develop his devices.[7] He was mainly concerned with hydraulics, but, given the interests of the period, he dealt also with balloons, steam engines and weaponry. Though tedious it may be, a detailed account is necessary to apprehend the inventor's daily struggle for his mechanical ideas.

21.1 An "Hydraulic Engineer" Seeks Recognition

Campmas' first attempt to gain the Academy's approval occurred on March 12, 1774. He presented three different machines for grinding wheat, sawing stones and pumping water, but the commission (Le Roy, d'Arcy and Vaucanson) reported negatively on his proposals six weeks later.[8] After this first failure, Campmas kept his distance for several years. He worked for noblemen and entrepreneurs in his province of Guyenne, mainly in the castles around Bordeaux and in that colonial and wine seaport itself, settling thereafter in Paris in early 1781.[9] On March 7 of that year, he presented to the Academy a "novel naval carriage" supposed to sail upstream on its own using the stream's own power. Gaspard Monge, named as reporter with Bossut, probably told him that the memoir was to be rejected, and the inventor withdrew it two weeks later.[10] Campmas had no more success with the various inventions he presented later: a capstan on March 2 and 9, 1782 (report by Coulomb and Bossut, May 8, 1782),[11] four hydraulic machines on April 24, same year (report by Le Roy and

[7] Liliane Hilaire-Pérez has given an outstanding analyze of the strategies of inventors in her comparative approach with Britain (*Inventions et inventeurs en France et en Angleterre au XVIII^e siècle*, Ph.D., Université Paris I/Panthéon-Sorbonne, 1994, 4 vols.; *L'invention technique au siècle des Lumières*, Paris, Albin Michel, 2000). See also Roger Hahn, *The Anatomy of a scientific Institution: the Paris Academy of Sciences, 1666–1803*. Berkeley: University of California Press, 1971, for the competition with the Academy. Thébaud-Sorger, *L'Aérostation...*, op. cit.; Catherine Lanoë, *La poudre et le fard. Une histoire des cosmétiques de la Renaissance aux Lumières*, Seyssel, Champ Vallon, 2008; Christiane Demeulenaere-Douyère, "Entre obscurité individuelle et gloire collective? Une société d'inventeurs sous la Révolution", in Patrice Bret, Hélène Gispert, Gérard Pajonk eds., *Savants et ingénieurs entre la gloire et l'oubli. Figures du progrès, imaginaires sociaux et construction historique de catégories culturelles*, Paris, Éditions du CTHS, in press.

[8] Archives of the Academy of Sciences, Paris (AAdS), "*pochettes de séance*" (*pochette*) March 12 and Apr. 23, 1774; "Procès-verbaux de l'Académie des sciences", mss. (PVAS) 1774, f° 98 and 137v–138v.

[9] His memoirs and plans presented at the Academy in 1782 (AAdS, *pochette* Dec. 7, 1782) are signed at Paris (April and July 1774 and again from April 1781 onwards), and meanwhile at Bordeaux (Oct. 1776, March 1778) and in various neighbouring places: castles of La Fite-en-Médoc (Apr. 1775), of Granet entre-deux-mers (Oct. 1776), of Saint-George-en-Pui (Oct. 1777), of Citran-en-Médoc (May to Sept. 1779).

[10] Ibid.

[11] AAdS, *pochette*, May 8; PVAS 1782 f° 32, 37v and 82.

Coulomb, March 1st, 1783)[12]; towing machines and other hydraulic devices on February 18, 1784, completing a 5-foot model submitted two weeks earlier (Legendre, Laplace and Le Roy were named reporters).[13] Two years later, the same group was commissioned to assess his "novel kind of pump", but before providing a definitive opinion they required experiments, which were never performed (April 7, 1786).[14]

Campmas on occasion preferred registering sealed envelopes (*plis cachetés*) to be opened only at his request. That permitted him to have his inventions secured and duly dated. The first and heaviest among the envelopes, n° 181 (December 7, 1782), contained "figures or drawings of machine" (see Figs. 21.1 and 21.2). It included the same 14-page memoir that he had withdrawn from

Fig. 21.1 Sealed envelope (*pli cacheté*) #181 (AAdS, *pochette*, Dec. 7, 1782). Up to down: brief description by Campmas (date of closing: Apr. 15, 1782); registration by Condorcet (Dec. 7, 1782); mention of opening by the Academy (March 7, 1977). Courtesy of the Academy of Sciences, Paris

[12] AAdS, *pochette*, May 8; PVAS 1782 f° 76 and 1783, f° 70. See Matthias Thomas-Hercent, "Les innovations du cabestan dans la France des Lumières", Master thesis, University François Rabelais, Tours (Pascal Brioist supervisor, Centre des études supérieures de la Renaissance), 1999, 185 p.

[13] AAdS, *pochette*, May 8; PVAS 1782 f° 76 and 1783, f° 70.

[14] AAdS, PVAS 1786, f° 146v–147v.

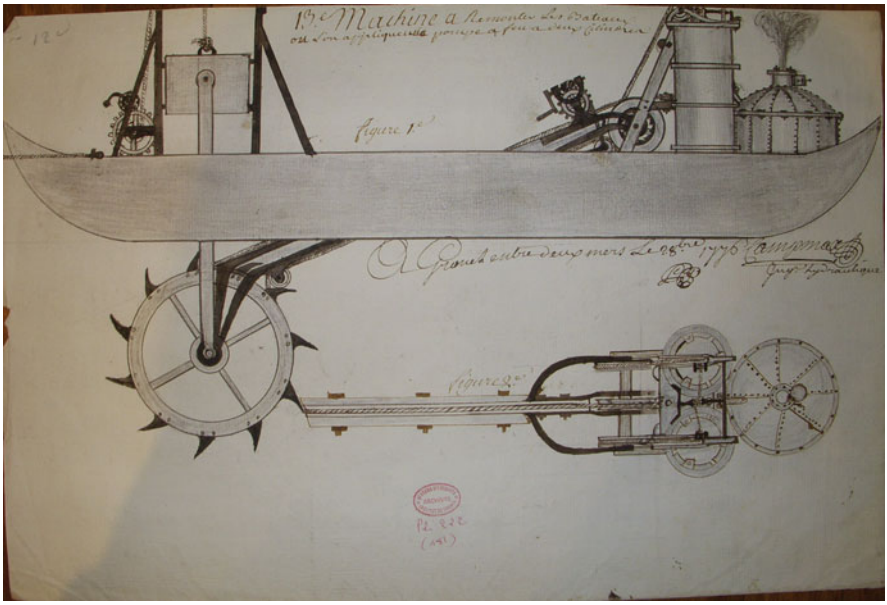

Fig. 21.2 "13th machine for towing boats, where a two-cylinder steam engine is applied", Granet entre deux mers, Oct. 2, 1776 (AAdS, *pochette*, Dec. 7, 1782). Here steam-driven, Campmas' first model of mobile cogwheel could use several sorts of power. Courtesy of the Academy of Sciences, Paris

Monge the previous year, together with sixteen additional pages of new details. Several other sealed envelopes were registered in 1783.[15]

Campmas then decided to participate in the public contest opened this year by the Academy on behalf of the King for restoring or replacing the famous Marly machine, built a century earlier by Rennequin for Louis XIV in order to pump water from the Seine to his chateaux at Versailles and Marly. The proclamation was first issued in 1785, but the contest was then prolonged two more years, with the hope of obtaining better proposals. All the applicants presented anonymously, identified only by a motto or an epigraph. Campmas proposed four different projects, in at least two sets of anonymous memoirs and plans: a 30-page one bearing the motto *Multiplex et una*, registered under n° 31, and a longer one, *Mobilitate firma* (69 p.) under n° 70. The reporters named by the Academy were Borda, Bossut, Coulomb, Perier and Monge, later replaced with Vandermonde – most of them could have recognized that these

[15] AAdS, *pochettes*: n° 223 (January 18) was a "parcel" concerning four new hydraulic machines, including a permanent fountain and a pump without piston; n° 224 (January 22) contained a "very small discover, detailed with nine figures and explanations" about "new permanent pens" (i.e. metallic and fountain pens) – Campmas asked for its opening and resealed in on July 24, 1797; and n° 232 (December 13) had "useful discoveries detailed with six figures", dealing with air navigation. There is some doubt about n° 222, which is mixed in n° 181, but another invention by Bonnemain is registered under this number (*Plis cachetés*, "Liste des dépots faits à la cidevant Académie des Sciences depuis l'année 1776 jusqu'en l'année 1792").

anonymous submissions were his. Although he did not win the competition, which had a monetary award, he did receive one of the six special mentions (*accessits*) among more than 45 applicants.[16] On May 12, 1787, only a few days after the prize was proclaimed at the Easter public meeting of the Academy, the inventor borrowed his own memoirs from the permanent secretary (*secrétaire perpétuel*) Condorcet, promising to bring them back when the secretary asked. Unfortunately, that never happened, and we are therefore unable to know the details of these projects, though elements of them can be guessed from Campmas' previous and subsequent applications.

The Royal Academy was not the only place to have one's inventions approved and to obtain further funding.[17] An alternative was to apply to the ministerial authorities. Thus, in April 1782, Campmas wrote directly to Amelot de Chaillou, State Secretary of the King's Household (*Maison du Roi*), requesting an "exclusive privilege" to exploit machines that enabled boats to sail upstream on their own: he later enclosed essentially the same concepts in his sealed envelope for the Academy, propelled by various kinds of power (man, water, steam) and with several underwater driving mechanisms (wheels, legs) (see Fig. 21.3). Amelot immediately forwarded the request to the mayor (*Prévôt des marchands*) of Paris, Lefèvre de Caumartin, who returned the advice of the Town Board (*Bureau de la Ville*). The Board wisely proposed experiments to see whether the machines would work, since the inventor would not describe his jealously-guarded mechanical secrets.[18] These Campmas had safely enclosed in his first sealed envelope at the Academy.

Another alternative to the Academy's support was aristocratic patronage. In a later (1800) claim for priority, Campmas provided the National Institute (*Institut national*) with a copy of a plan dated 1773. He asserted that the pump which he had presented in 1786 was the same suction and force device that he had designed thirteen years earlier, and on which Borda and Meusnier had reported that same year. Although members of the Academy, these two (both engineers and physicists) were not at that time acting within an academic commission, but as experts on behalf of Lieutenant-General Duke of Harcourt, governor of Normandy (1775–1789) and governor of the Dauphin (1786–1789),[19] whose support Campmas was then seeking. While claiming priority in 1800, the inventor referred neither to the negative assessment that the Academy had produced in 1774, nor

[16] See Mathilde Lardit, "Les concours de l'Académie royale des sciences", Master thesis, Université Paris I Panthéon-Sorbonne (Daniel Roche supervisor), 1997, pp. 116–117.

[17] See Hilaire-Perez, L'invention technique, op. cit.

[18] AN, O^1 1294, #12–14. Quoted by Liliane Hilaire-Pérez, *Inventions et inventeurs en France et en Angleterre au XVIII^e siècle*, Ph.D., Université Paris I/Panthéon-Sorbonne, 1994, vol. I, p. 63.

[19] François-Henri d'Harcourt (1726–1802), count of Lillebonne, 5th duke of Harcourt (1783). Let us notice that the three people involved in the alleged 1786 assessment were no longer able to testify in 1800: Meusnier was killed at the siege of Mayence in 1793, Borda died in 1799 and the Duke of Harcourt was still in emigration, as the representative of Louis XVIII to the British government.

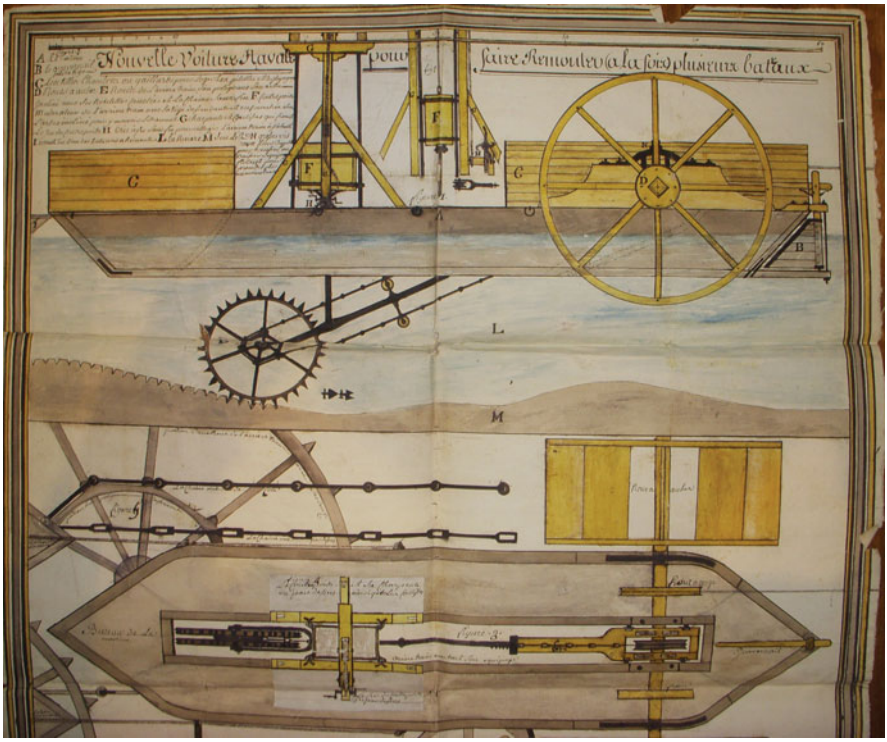

Fig. 21.3 "New naval carriage for towing several boats at the same time", Paris, March 1, 1781 (AAdS, *pochette*, Dec. 7, 1782). Paddle wheeled tugboat here driven by tugboat tracted bequipped with Campmas' second model of mobile cogwheel. Courtesy of the Academy of Sciences, Paris

to the above mentioned memoir that he did submit on the machine, but which Legendre, Laplace and Le Roy did not fully evaluate in 1786.[20]

In yet another effort to make money from his inventions, Campmas claimed he had improved the recently invented Vera's machine that pumped water with an endless rope, as early as November, 1781 in the gardens of Lieutenant-General Marquis de Crussol d'Amboise,[21] rue de Sève [Sèvres], at Paris. In June 1782, the jealous inventor gave a description of his improvement in a letter to the *Journal de Paris*, and announced the publication of a print describing a "Machine for rising water with a rope" in the *Mercure de France*: the engraving

[20] *Procès verbaux de l'Académie des sciences*, printed (*PVAS*) II, Germinal 26, Year 8, pp. 142–143.

[21] Anne Emmanuel François Georges de Crussol, Count d'Amboise (1726–1794) had also a military command in Normandy in 1789, when he was elected to the *Etats généraux*. He was beheaded on July 26, 1794 – one day before Thermidor 9.

sold for either 3 £ with explanations, or 1 £ 16 s. (1 *livre* 16 *sols*) without.[22] There was no need do keep his plans secret by that time. Numerous other improvers had made experiments and had provided descriptions of this simple, cheap and therefore fashionable machine, which could soon be found elsewhere, notably in Pilâtre de Rozier's experiments, which were published in the August issue of the *Journal de physique*,[23] or in Marsilio Landriani's *Description d'une machine propre à élever l'eau par la rotation d'une corde verticale* (Geneva, 1782). Campmas' print may have sold well, although the mathematician and physicist Antoine Deparcieux soon proved that the output of the machine that it pictured was only half that of an ordinary pump with a piston.[24]

When Campmas left Bordeaux for Paris in 1781, and soon failed again at the Academy, he came to the conclusion that inventions were better judged publicly, especially for those who, like him, were not able to get any institutional support.[25] Publishing pamphlets and announcements in journals was the best way to get publicity, notoriety, and support. Campmas thereafter frequently published either in the only French daily newspaper, the *Journal de Paris*, in the *Journal général de France*, which appeared every two days, or in a dozen or so weekly, bimonthly and monthly literary journals and other magazines. As in his surviving letters and memoirs, these pieces of information merely show his slant on the events. Fortunately the journals also provided a venue for critics, and here Campmas' story meets history, in particular around the birth of aviation.

Campmas began an offensive strategy. In October 1781, he announced his arrival from Guyenne in the *Journal de Paris*.[26] Two months later, he published a lengthily list of his inventions in two different periodicals: he began with twenty-one inventions for the capital city in the *Journal politique, ou Gazette des gazettes*, followed by twelve more for Paris and fifteen for the provinces in the *Journal encyclopédique*,[27] including self-towing machinery for boats, various devices powered by men, horses, wind, fire, and several others, such as a powder mill and new machinery for Marly. Then, he wrote a letter to Pahin de La Blancherie – who published it in his *Nouvelles de la République des Lettres et des Arts* – in which he referred to his first proposal for pumping water out of ships as early as 1774.[28] Cleverly, he was even able to find unexpected support through the fame of one

[22] *Journal de Paris*, June 19, 1782, p. 689. *La Machine à élever l'eau par une corde sans fin, perfectionnée par M. Campmas, Ingénieur-Hydraulique* is the print wrongly attributed to the physician J.-F. Campmas after *La France littéraire*.

[23] See also *Encyclopédie méthodique. Arts et métiers mécaniques*, Paris, Panckoucke; Liège, Plomteux, vol. III, 1784, pp. 688–690.

[24] *Dissertation sur le moyen d'élever l'eau par la rotation d'une corde verticale sans fin*, Amsterdam, 1782 (not seen).

[25] Campmas lived at the Hôtel St-Louis, rue Gît le Cœur, at least from December 1781 up to May 1787.

[26] Oct. 2, 1781, vol. 2, p. 1109.

[27] Respectively Dec. (second fortnight), pp. 78–81 and vol. 8, part 3, Dec. 15, pp. 516–519.

[28] 1782, p. 4.

competitor, when he claimed in several journals that he had been the first to take advantage of Vera's machine.[29] And he took advantage of every opportunity to have his name and address published: regarding the recent terrible earthquakes in Calabria, while confessing his lack of scientific knowledge, especially in chemistry and mineralogy, he nevertheless offered hypotheses about volcanoes and earthquakes in the *Journal de literature, des sciences et des arts*.[30] But the *Mercure de France* and its attached second part (the *Journal politique de Bruxelles*) became his favored media for advertising.[31]

As early as 1779, Campmas had also published a small pamphlet on hydraulic work under water.[32] In 1782, as we already noted, he published the engraving of his "Machine for rising water with a rope". It seems that neither the pamphlet nor the engraving exists today, unlike two later ones that appeared after the climax of the French Revolution: *Plan général des finances, nouvelles fabriques monétaires, moulins nationaux et greniers d'abondance d'un nouveau genre*... at the very beginning of the Directoire regime (October 1795),[33] and *Lettre du Cit. Campmas, ... sur son projet de deux grands établissements pour la ville de Paris, divisés en six objets d'utilité majeure* at the eve of Bonaparte's government (November 1799).[34] This last was an offprint of a letter sent to the *Moniteur universel* calling for funds – through a notary and a police superintendent – to support his project to convert the *Salpêtrière Hospital* in the eastern districts of Paris and either the *École militaire* or the island of Swans (*île des Cygnes*), in the Seine River, in the western part, into arms factories, powered with a machine similar to the one he had built in Amboise a dozen years earlier.

21.2 From Industrial Plants to Priority Disputes

From 1789 onwards, Campmas was able to base new proposals on his own experience in Amboise on the Loire River, east of Tours, where he got his best opportunities for developing in his engineering at the very end of the Ancien

[29] Letter to the *Journal de Paris*, June 19, 1782, p. 689, *Journal politique, ou Gazette des gazettes*, Aug. (first fortnight), 1782, p. 90.

[30] "Réflexions de M. Campmas, Ingénieur-hydraulique, sur les désastres de la Calabre & de Messine", 1783, vol. 3, pp. 7–12.

[31] For example, Dec. 28, 1782, n° 52, p. 184; March 22, 1783, p. 238.

[32] *La France littéraire*, 1779, p. 589.

[33] *Plan général des finances, nouvelles fabriques monétaires, moulins nationaux et greniers d'abondance d'un nouveau genre, présenté au Conseil législatif des Cinq Cens, par le citoyen Jean-Pierre Campmas... 4 brumaire an IV* [Oct. 26, 1795], Paris, n.d., 4p., in 4° (Bibliothèque nationale de France, Paris (BnF), Rp 13446). The proposal to the newly elected legislative assembly was made the last day of the National Convention.

[34] *Lettre du Cit. Campmas, ingénieur en hydraulique, sur son projet de deux grands Etablissemens pour la ville de Paris, divisés en six objets d'utilité majeure; au rédacteur du Moniteur universel. Paris, le 20 nivôse an VIII* [Jan. 10, 1800]. Paris, impr. de H. Agasse, n.d., in 8°, 13 p. (BnF, Vp 13079).

Regime. His aristocratic patronage, the positive appreciation by the academy of his project at the Marly Prize, and his own advertising strategy at last yielded a major mechanical building operation indeed. After borrowing his memoirs on the Marly machine from Condorcet in May 1787, he moved to Amboise. It seems that he was called there – possibly via Crussol d'Amboise's influence – by the entrepreneur Sanche (since 1782 manager in Amboise of the ironworks) in order to build hydraulic machines to drive the hammers of his "Royal manufacture of fine steels". In 1789, this large industrial plant had six working furnaces (of the twelve that had been built), forty hammers and eighty steel forges.[35] Even though the local production was not good enough to challenge British steel in quality, official certificates attest that Campmas' hydraulic machinery itself was quite successful. In 1793, the Consultative Board for arts and crafts (*Bureau de Consultation des arts et métiers*) therefore gave him its maximum "national award" (*récompense nationale*) of 6,000£ for "having conceived and executed successfully the mechanical part of the steel plant at Amboise", i.e. "the mills to hammer the steel and to blow the forges".[36] Campmas asserted that his equipment had even withstood the breaking up of the frozen river which had carried away the bridge in January 1789. From this point on he could rely on strong references.

Yet things at the Amboise steel plant were not quite so positive. A report by a local administrator (*subdélégué de l'intendant*), in March 1789, states that the mills on the river were not powerful enough, and that the dyke built to supply them with water was itself charged by the inhabitants with the recent disaster that had destroyed the bridge when the river unfroze.[37] But the construction of his equipment nevertheless continued while the engineer rented a flat at a local lawyer's residence (Gitton, later vice-president of the district).[38] There Campmas also designed one of the various projects for rebuilding the bridge,[39]

[35] Hilaire-Pérez, *L'invention technique…*, op. cit., pp. 281–282, 295; Denis Woronoff, *L'industrie sidérurgique en France pendant la Révolution et l'Empire*. Paris: EHESS, 1984, p. 352; Charles Ballot, *L'introduction du machinisme dans l'industrie française* (Paris, 1923). Reprint, Geneva: Slatkine, 1978.

[36] Archives du Musée national des arts et métiers, Paris, 10–544 #105. The experts named by the *Bureau de consultation* on May 9, 1792 were not members of the Academy, but representative of inventors societies (Lucotte, Trouville and Dumas). On August 25, Campmas only received 950£ after the legal tax of 5%, since he had already obtained 4,750£ on July 21 (AN, F^4 1316). See Charles Ballot, "Procès-verbaux du Bureau de Consultation des Arts et Métiers", *Bulletin d'histoire économique de la Révolution,* 1913, pp. 95, 98, 140.

[37] AD Indre-et-Loire, C 143, quoted by Georges Rosenberger, "Production et usage de l'acier en France au XVIIIe siècle. Tentative de bilan", in Philippe Dillmann, Liliane Pérez et Catherine Verna (eds.), *L'acier en Europe avant Bessemer*, Toulouse, CNRS/FRAMESPA, Editions Méridiennes, 2011, pp. 339–357 (p. 355).

[38] Service historique de la défense/ Département armée de terre, Vincennes (SHD/DAT), 6 W 66, dos. 6033(7), p. 3.

[39] AD Indre et Loire, C. 738.

and he made numerous tests on the devices that he had invented, continuing at least until the summer of 1791.[40]

After he moved back to Paris, Campmas joined the *Société du Point central*, one among a number of newly-founded ones for inventors which challenged the old Academy.[41] In Year II (1793–1794), he settled in the cloister of the former cathedral church Notre-Dame, soon to be renamed the Temple of the Reason, on the île de la Cité, where many instrument-makers and artisans were housed.[42] On the 18th of the first month of Year II (October 9, 1793), his new project for restoring the Marly machine was entrusted to Coulomb, Trouville and Le Roy at the Consultative Board for Arts and Crafts. This time the Board granted him the medium award of the first class (5,000£ in *assignats*) on April 3, 1795.[43] Moreover, since a new contest on Marly had been proposed by the Committee of Patrimony and Alienation (*Comité des domaines et aliénation*) of the National Convention, his proposal was also included in the final report for that contest by Prony and Molard, thereby providing information on Campmas' project, along with those of his competitors. This was likely similar to the one that he had proposed six years earlier, which involved a unique suction and force pump using only one wheel that was designed to bring water from the river to the aqueduct in a single flow. Though they congratulated Campmas for his hard work and clever ideas, the committee still thought that the flow should be divided in two or three parts, as it had been in the 1680s by Rennequin's device.[44]

When the new Constitution of Year III restored the ministries and created the National Institute – the first class of which replaced the Academy of Sciences – Campmas first neglected the new academic power and preferred applying to the political power. But the latter usually forwarded to the former. Thus, in September 1796, his memoir to the Minister of the Interior on three

[40] SHD/DAT, 6 W 66, dos. 6033(7), p. 3. In 1793, the steel plant was converted into blades manufacturing when Amboise was besieged by the royalist rebellion (*Vendéens*), but Campmas' mills were destroyed in the Revolutionary years.

[41] He was registered after Oct. 9, 1792 (Archives du Musée national des arts et métiers, 10–932).

[42] Enclos de la Raison (alias Cloître Notre-Dame), #46 until 1801 at least. Previously : Hôtel de Provence, rue St-André des arts (May 1792), Caffé de Conty, descente du Pont neuf (October 1792).

[43] Archives du Musée national des arts et métiers 10–544 #290. At that time (Ventose 20, Year 3/March 10, 1795), Campmas asked the Provisional Commission of Arts to seek in Condorcet's papers so as to find out three of the memoirs he had presented to the formerAcademy (Louis Tuetey, Procès-verbaux de la Commission temporaire des arts. Vol. II, Paris, 1917, p. 167).

[44] Convention nationale, *Rapport de Prony et Molard sur les projets présentés au comité des domaines et aliénation, pour remplacer la machine de Marly. Imprimé par ordre de la Convention nationale...*, Paris, Impr. nationale, Du 15 vendémiaire, l'an III de la République [Oct. 6, 1794], pp. 12–14 (description) and 17–19 (comments).

naval machines came to the National Institute, where Prony and Bory decided to postpone the assessment until the Consultative Board had been replaced.[45] The Minister of Finances did the same with a more original project for stamping money, including a hydraulic machine in the Mint, and an underground water supply for it. That project had been first alluded to one year earlier by Campmas in his *Plan général des finances*: it was intended to be less expensive and "at least one hundred time faster" than existing machines in order to keep only one Mint in the Republic.[46] This was now assessed by Prony and Darcet, later by Perier. They were clearly annoyed with the inventor's wish to keep his plans secret and by his criticisms of the judges themselves: he challenged Perier's objectivity as being both judge and judged (Perier controlled the water supply in Paris), and Prony, whose previous report on the Marly machine had brought "a fatal strike to his reputation". They asked for more detailed explanations, and waited for "a sufficient knowledge about his projects and plans".[47] Then, in February 1797, both ministers forwarded several new letters and memoirs from Campmas, in particular one concerning a steam engine for the Mint, which were once more entrusted to Perier and Prony.[48]

Despite these disputes, Campmas later applied directly to the National Institute. At first, in Summer 1797, he did not request an assessment, but only borrowed his sealed envelope on metallic pens that had been registered in 1783; he registered it again, and soon registered as well two new sealed envelopes on "a discovery which could become useful", probably on the same object.[49] Twice, he asked only for a dated certificate: one for the new, stronger and longer metallic pipes to supply water and the model of a hydraulic machine that he presented next spring, the other for a memoir on "new vaporous pneumato-chemical baths and aromatic fumigations" in December 1798.[50] But in and after the previous spring, he had also asked for regular applications. On March 21, with Bonaparte chairing the meeting, Campmas read a memoir on the construction of a hydraulic machine; he read another on October 2 and a third, on the Marly machine again, was forwarded by the Minister of the Interior on November 6. The same reporters (Charles, Brisson and Le Roy) were named the three times, but no report was yielded and one year later, on October 28, 1799, Campmas presented his umpteenth hydraulic machine.

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[45] *PVAS* I, pp. 96 (Fructidor 26, Year 4/Sept. 12, 1796) and 106 (Vendémiaire 1st, Year 5/Sept. 22, 1796).

[46] AN, F^{17} 1240 B. *Plan général des finances*. . ., op. cit., p. 3. From April 1796, Campmas was replacing Dumas as hydraulic engineer in charge of setting up a copper rolling mill on a floating factory on the Seine River (AAdS, pochette, Vendémiaire 11, Year 5/Oct. 2, 1796).

[47] *PVAS* I, pp. 113 (Vendémiaire 11, Year 5/Oct. 2, 1796), 136 (Frimaire 6/Nov. 26), 150 (Nivôse 6 and 11/Dec. 26 and 31).

[48] Ibid., pp. 171 (Pluviôse 21, Year 5/Feb. 9, 1797), 172 (Pluviôse 22/Feb. 10).

[49] Ibid., pp. 241–242 (Thermidor 6 and 11, Year 5/July 24 and 29, 1797), 258 (Fructidor 1/Aug. 18).

[50] Ibid., pp. 362 (Ventôse 26, Year 6/March 16, 1798), 502 (Frimaire 21, Year 7/Dec. 11, 1798).

That very day, two other inventors, Vincent Bidot and Charles Thilorier, also presented pumps: the reporters in charge for Campmas were Le Roy, Brisson and Charles; for Bidot there were Perier and Prony, later joined by two naval engineers, Forfait – also Minister of the Navy – and Sané, while Thilorier had Perier and Forfait.[51] In February 1800, as already noted, Campmas asserted his priority, claiming that he had invented a pump similar to Bidot's as early as 1773 and proposed an improved version in 1786.[52] Bidot's reporters mentioned these claims, but declared that they were far from thinking that he was not able to invent his own device: "We think very probable that he has only met the idea of another, very common accident among those who busy themselves with applied mechanics".[53] They also added that "checking Citizen Campmas' original titles are not included in the objects the [first] Class [of the Institute] has to know."[54] The day the report was read, on March 27, Bonaparte – now the First Consul – was chairing, and Campmas presented a model of a machine that used rolling and pitching to drive onboard pumps. At the next meeting, five days later, the illustrious chairman put Carnot and Bory in charge of this invention.[55] Campmas then argued against the resulting report, and asked that a due record of his counter-claims be made. He sent it to the Ministry of the Interior, Napoleon's brother Lucien Bonaparte, to complain about the behavior of the Institute towards him, with copy to the accused, and he wrote again to the Institute, reclaiming against the order of the day, which neglected his letter.[56] By the way, he also asked for the final report concerning his memoir of September 1796 on naval machines – Monge had joined his colleagues Prony and Bory for that evaluation, but the commission had not completed its work.[57] The contentious was no longer between the inventor and his competitor, but now with his National Institute itself. It now reached its climax, and Campmas never applied any more.

Moreover, Bidot was not the only inventor attacked by Campmas. At the same time, the bitter *ingénieur en hydraulique* published his above mentioned letter to the *Moniteur universel*, regarding the conversion of the *Salpêtrière Hospital* and the *École militaire* into arms factories: his aim in doing so was to assert priority against similar projects previously exposed in a letter from another engineer, Brullée, to this journal: "For a long time, I have let know my views on that matter to many people, and indeed to Citizen Brullée's associates; they are not less my property, whatever distorted shape he might

[51] *PVAS* II, pp. 20–21 (Brumaire 6, Year 8/Oct. 28, 1799).

[52] Ibid., p. 111 (Ventôse 6, Year 8/Feb. 25, 1800).

[53] Ibid., p. 142 (Germinal 26, Year 8/Apr. 16, 1800).

[54] Ibid., p. 143 (Germinal 26, Year 8/Apr. 16, 1800).

[55] Ibid., pp. 128–129 (Germinal 6 and 11, Year 8)

[56] Ibid., pp. 146 (Floréal 6, Year 8/Apr. 26 1800), 156 (Floréal 16/May 5), 173 (Prairial 11/May 31), 175 (Prairial 21/June 10).

[57] Ibid., p. 146 (Floréal 6, Year 8/Apr. 26, 1800).

have presented them to the government".[58] More and more, he felt robbed of both credit and possible funds by his competitors.

In Fall 1801, the Society for the Encouragement to National Industry (*Société d'encouragement pour l'industrie nationale*) was created in order to join administrators, scientists, bankers, entrepreneurs and inventors in a common endeavor. Chaptal, industrial chemist and minister of the Interior, was the president.[59] Campmas applied to the new institution as soon as January 25, 1802. The "intolerable conditions" attached to his proposal for 24 machines – these conditions are not known, but seem to be financial, either to sell models or to get funding to develop his devices – were rejected by the Committee of Mechanical Arts one month later, as being contrary to the by-laws of the society.[60] He also participated twice in the 1801 "Exhibition of the products of the national industry" at the Louvre, with a "machine for preventing shipwreck", and in the following year's exhibition as well, but the *Jury des arts* in charge of distribute premiums and medals did not grant him any award. In fact, that machine – a force pump – had already been sent to the Minister of the Interior, tested at the Swimming School (*École de natation*) on the Seine River, and even awarded 1,200 francs after a report by Bralle and Montgolfier for the new Consultative Board for arts and manufactures.[61] But the inventor's last alternative, which had little chance of success, was to find private support, and through the *Moniteur universel* he invited people to visit his cabinet of machines at the cloister Notre-Dame in October 1801.[62]

Campmas did not merely work on hydraulic matters. Certainly, he had presented himself as a "hydraulic engineer" (*ingénieur hydraulique*) at the end of the Old Regime – and occasionally as an "engineer privileged by the King" (*ingénieur privilégié du Roi*), despite the fact that he had obtained nothing more than a privilege to sell his prints on hydraulic machines – then as an "engineer in hydraulics" (*ingénieur en hydraulique*) during the Revolution. But he also called himself "*physicien*". This equivocal term, which could be used as well for physicists and natural philosophers, was mainly prized by the first aeronauts – Pilâtre de Rozier was a true demonstrator of physics indeed – and other balloon demonstrators, most often amateurs of various professions with a more or less light tincture of chemistry and physics. Campmas became deeply involved in ballooning from 1783 onwards.

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[58] *Lettre du Cit. Campmas… sur son projet de deux grands Etablissemens…*, op. cit., pp. 1–2. Brullée's letter had been published on January 1, 1800.

[59] Serge Benoît, Gérard Emptoz, Denis Woronoff (eds.), *Encourager l'innovation en Europe. La Société d'encouragement pour l'industrie nationale*, Paris, Éd. du CTHS, 2006.

[60] Costaz, Baillet, Molard, Bardel and Conté belonged to the Committee. Archives of the Société d'encouragement pour l'industrie nationale, Procès-verbaux, Pluviôse 5 and Ventôse 5, Year 10, and Campmas' file (CME 1/1).

[61] AN, F^{12} 2422. I am grateful to Marie Thébaud-Sorger, who drew my attention on this file.

[62] Brumaire 8, Year 10 (Oct. 30, 1801).

21.3 Ballooning in War and Peace

After the Montgolfier brothers and "the invention of aviation", as Gillispie termed it, what had been a spectacular social phenomenon were followed by large numbers of aerial projects throughout France. Campmas could not stand aside from this fashion.[63] Moved by his passion for inventing passion and his hope to earn money, like many other "*physiciens*" Campmas tried to turn to aerial demonstration and navigation. Again like so many, he did not succeed, for he failed to solve the major problem of steering balloons.

As he had for hydraulics, Campmas undertook both public announcements in the journals and secret applications to the Academy. As early as September 1783, he published his first papers on that problem, announcing forthcoming trials both in the *Gazette d'agriculture* (n° 76) and the *Mercure de France* (n° 40). On September 28, he produced a design for a hot air balloon, with an alembic as an improved heater to catch the resulting "aqueous vapors" (see Fig. 21.4). Three months later, he enclosed the design and registered it under n° 232 with the Academy, as "useful discoveries detailed with six figures". In a note following this two-and-a-half-page memoir, he remarked: "If sphericity were not the most advantageous shape, I shall give the Globe that of an egg, a rounded-off [h]exagon, in order to bring back more quickly the vapor condensate around the active firebox".[64] Meanwhile, in a letter to Étienne de Montgolfier dated November 28, 1783, he claimed that he had built several hot air balloons in Paris and in an unspecified province, but that he had mistakenly confided in "an Englishman" (who remains unknown), and that man had published Campmas' letter in the *Mercure de France* and the *Journal de Paris*.[65] Like Jean-Pierre Blanchard and other famous aeronauts, and even Lavoisier and Meusnier at the Academy of Sciences, Campmas was confident in the potential of aerial navigation.[66] He soon projected an "aerial diligence" (*diligence aérienne*) and pretended that he was able to move it as he pleased, with man-powered steers and rows, and other secret means. He sent entrance tickets to a public

[63] Charles C. Gillispie, *The Montgolfier Brothers and the Invention of Aviation, 1783–1784. With a Word on the Importance of Ballooning for the Science of Heat and the Art of Building Railroads*. Princeton: Princeton University Press, 1983. On the fashion, see James M. Hunn, *Balloon Craze in France: A Study of Popular Culture, 1783–1799*, PhD Vanderbildt University, microfilm, Nashville, 1982; Lynn, *Popular Science*..., op. cit.; Thébaud-Sorger, *L'Aérostation*..., op. cit.

[64] AAdS, *pochette* Dec. 13, 1783.

[65] Musée de l'Air et de l'Espace, Le Bourget, fonds Montgolfier, Box XXI, #24.

[66] Van Marum reported a discussion on that point, after the July 20 meeting at the Academy, between Lavoisier, who was confident in Meusnier's work, and Laplace, who considered steering a balloon impossible (Martinus Van Marum, *Journal physique de mon séjour à Paris 1785*, in *Martinus Van Marum. Life and Work*, ed. R. J. Forbes, Haarlem, 1970, vol. II, pp. 220–239). Regarding the academic assessment, see "Lavoisier et les deux commissions académiques successives pour l'étude des aérostats", Œuvres de *Lavoisier – Correspondance*. Vol. IV, Michelle Goupil, ed., Paris, Belin, 1986, pp. 293–297.

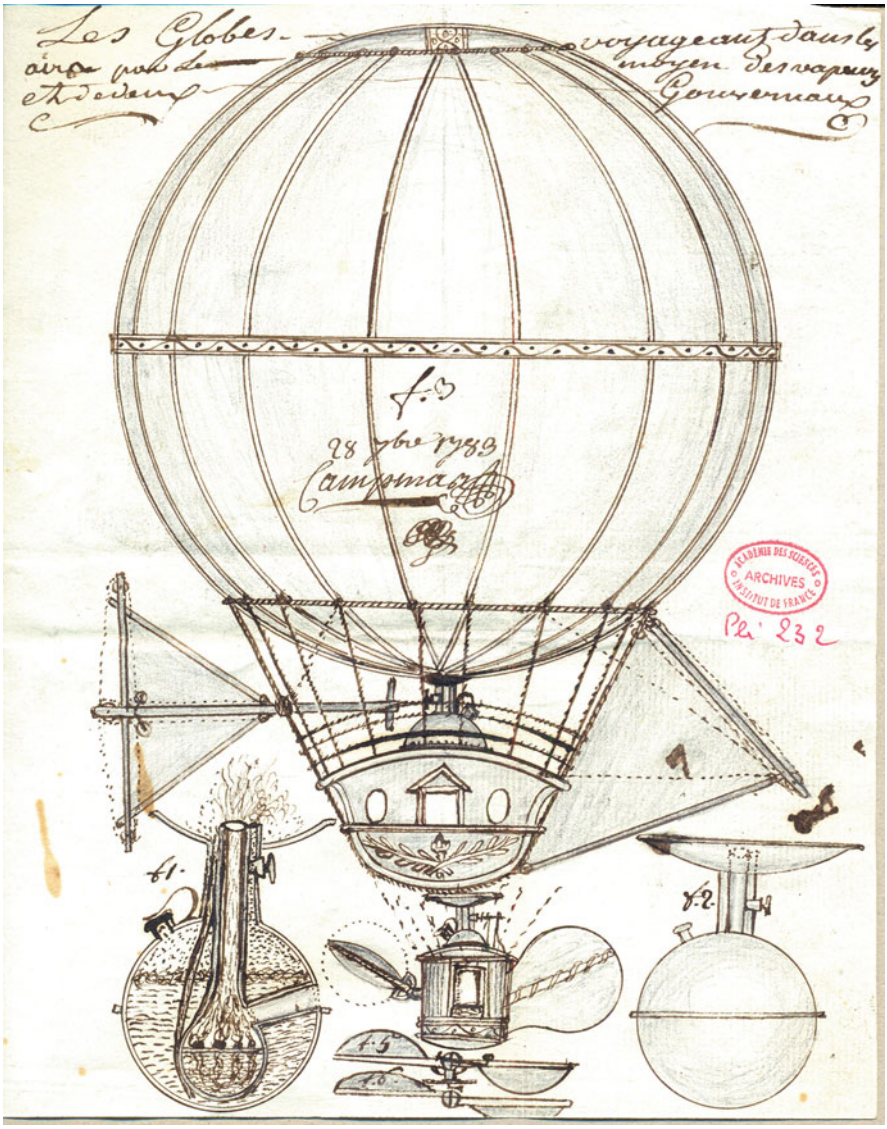

Fig. 21.4 "The Globes travelling in the air by means of vapors and two rudders", Paris, Sept. 28, 1783 (AAdS, *pli cacheté* #232, *pochette*, Dec. 13, 1783). Courtesy of the Academy of Sciences, Paris

demonstration of this aerial steering machinery that he claimed to have built to Montgolfier,[67] and sold them through public advertising. He arranged for three successive campaign announcements in various journals, each corresponding to one of his planned aeronautic exhibitions.

Campmas wrote one letter about his forthcoming exhibitions dated February 20, 1784 that was published four days later in *Annonces, affiches et avis divers, ou Journal général de France*, which was soon followed by his "observations". His proposed balloon was no longer spherical, but had its larger circumference of 152 feet and the narrower 82.[68] On March 9, he gave the date of his test, "next Friday"; two days later, he indicated the place and time: the Spiritual Concert Hall at the Tuileries, on March 12, at noon.[69] Nothing more is known about it: a model was probably on display, a means commonly used to obtain funds in order to construct a full-scale device.[70] Three months later, on Saturday June 12, Condorcet read at the Academy a letter from Campmas asking the members to visit his machine in the Queen's Gallery at the Tuileries after their meeting. The inventor urged them to come, because the Queen herself would soon arrive at her apartments there. Brisson and Meusnier were named by the Academy to do it, but they left no written account of their visit.[71] This exhibition of his machine – now "a rather high box fixed on castors", with moving strings or rows – had been announced in the *Journal politique* and the *Journal encyclopédique*.[72] After these preliminary exhibitions of the machine, Campmas announced his ascent around October 20.

On the 23rd of this month, he wrote again to the *Journal de Paris* to explain he had to postpone it, and gave a detailed account of the daily occupations of the forty workers involved in the preparation. "Nothing more entertaining than this description, which bears all the pomposity of a gasconade" the author of the *Mémoires secrets* reported.[73] The *Correspondance secrète*

[67] Musée de l'Air et de l'Espace, Le Bourget, fonds Montgolfier, Box VI, #58. The tickets bore an engraving of the steering machine, without the balloon: "Diligence aérienne de Mr. Campmas, ingénieur et physicien./Billet pour le départ de Mr Campmas et compagnie de voyage./Se trouve à Paris chez l'auteur rue Gît-le-Cœur quay des Augustins à l'Hôtel St-Louis. 1784" (BnF, Estampes, coll. Hennin, 10018).

[68] Feb. 24, 1784, pp. 112–113; Feb. 26, 1784, pp. 117–118.

[69] March 9, p. 142; March 11, p. 149.

[70] Bienvenu and Launay did the same with their heavier than air model. See P. Bret, "Un bateleur de la science : le 'machiniste-physicien' François Bienvenu et la diffusion de Franklin et Lavoisier", in Jean-Luc Chappey (ed.), "La vulgarisation des savoirs et des techniques sous la Révolution", *Annales historiques de la Révolution française*, n° 338 (Oct.–Dec. 2004), pp. 95–127.

[71] AAdS, PVAS 1784, f° 148v.

[72] Respectively June (first fortnight), 1784, pp. 39–40 and June 1784, pp. 497–498.

[73] The French term contains an ethnic connotation: "*gasconnade*" refers to inhabitants of Gascogne, a part of Guyenne – where Campmas came from – the Gascons, whose boasting was legendary. *Mémoires secrets pour servir à l'histoire de la République des lettres en France*..., London, John Adamson, 1786, t. 26, .pp. 258–259.

mocked Campmas again on December 1, 1784: Pilâtre's next aerial travel was now expected with much impatience and his machine was on display at the Tuileries, the very place where Campmas got hissed for his failed experiments. The inventor has now changed the shape of his device: "It is no more a tower, it is a horizontal cylinder that will be able to move in every direction. (. . .) But prudently, he never fixes the day of departure, & one does not hasten to subscribe, because the Abbot Miolan's promises are still reminded."[74] After so many failures of pseudo-aeronauts, people had confidence only in those who had already proved their ability to deliver, like Pilâtre: the first to have flown, he now planned to cross the Channel, which proved fatal to him and his companion the following month.

Thanks to this activity, and despite his failure, Campmas soon entered the annals of flying, for instance in David Bourgeois' 1784 *Recherches sur l'art de voler*, which mentioned Campmas' rowing wheel and "aqueous vapors", adding: "He has forgotten to explain how he could prevent the condensation of these vapors. He will be showered with praises, if he succeeds removing this obstacle".[75] The procedure for handling the "aqueous vapors" had been designed the previous year, as already mentioned. The rowing wheel was a human-driven wheel device that he had drawn on February 1 that same year for towing boats upstream, which he claimed to apply also to aerial navigation later (see Fig. 21.5). Referring to his previous sealed envelope, he then added: "Two months or so ago, I registered at the Royal Academy of Sciences, a memoir through which I propose to apply a similar mechanism in order to move horizontally Monsieur de Montgolfier's aerostatic machien. We will see the method in due time."[76] This was supposedly to be done, but the fact is that Campmas' aeronautical projects always remained fanciful.

When Campmas proposed his *Plan général des finances*, in 1800, a member of the Legislative Corps raised against it Campmas' previous failure in aeronautics. In reply the inventor added a special note following the main prospectus. He explained that he had lost all his wealth in the aerial enterprise before he had been called to "very major operations" – at Amboise – and had therefore not been able to carry on when he came back, since all his materials and machinery, kept in barracks, had been "devastated and carried away in the first troubles of the Revolution". Since he had no more devices to test nor money to build new ones, Campmas undertook a 400-page "Treatise of Balloonning" ("Traité d'aérostation") and presented it to the *Lycée des Arts* in

[74] *Correspondance secrète, politique et littéraire*, London, John Adamson, 1789, t. 17, 177–178. On July 11, Miollan and Janinet's balloon could not ascend and was eventually destroyed by furious – paying – spectators.

[75] David Bourgeois, *Recherches sur l'art de voler, depuis la plus haute Antiquité jusqu'à ce jour*, Paris, Cuchet, 1784, p. 88.

[76] AAdS, *pochette*, Feb. 18, 1784 (signed by Condorcet that day).

Fig. 21.5 Naval and aerial towing wheel, Feb. 4, 1784 (AAdS, *pochette*, Feb. 18, 1784). Top left: registration by Condorcet, same day, when Campmas presented a 5-feet model of the wheel at the Academy. Courtesy of the Academy of Sciences, Paris

1794. He asserted it was unanimously approved and awarded a medal and the most honorable mention.[77] The judges concluded that Campmas needed collaborators to build his machines, the smallest of which could carry 230 men, and added: "Considering attentively the enormous expenses that maritime navigation absorbs, we can easily think of spending three or four millions, if necessary, so as to realize an attempt, the success of which will bring rapture and happiness to all the peoples of the earth".[78] The treatise was never published. Probably it was not worth printing and nothing is known about the contents or the possible location of the manuscript, had it even survived. But Campmas did not drop his project for aerial navigation, and eventually adapted it for war.

On January 28, 1798, he sent to the Minister of War a "project for raid (*descente*) on England with a crew of 200 men, by a novel aerial vessel, intended to make France rich and bring happiness to all countries" – revolutionary rhetorics! – "an aerial vessel of a new kind, able to carry a crew of more than 200 men, who will be able to fly as they please and to cast lightning onto the British cabinet in order to make it capitulate".[79] On February 6, the minister, Scherer, named "Buonaparte", Fourcroy, Borda and Le Roy – of the National Institute – as reporters for the ministry. The general was busy inspecting the northern coastal forces, but the other members received the inventor at the Institute after their meeting on the 14th. Borda was a major theoretical and applied scientist, a pioneer of experimental hydraulics, the inventor of the geodetic "repeating circle" used for the new measurement of the Paris Meridian, and both a naval and military engineer, the reformer of the French naval building in the 1780s and currently a member of the commission for artillery trials at Meudon.[80] Rather skeptical about Campmas' proposal, he compared naval and aerial manœuvres and asserted that the power of aerial rowers would be nearly null – amounting on average to a fifth of their effort.[81] Campmas cited these doubtful remarks and dared to remark that Borda was a beginner in the field of aeronautics; in his next letter to the minister, he even asserted that the scientist had not read a line of either Campmas' memoir or the report of the other commissioners.[82] Indeed, a rather strange report was presented, apparently to Scherer, just before he was dismissed on February 21. The eleven-page minutes of the report concluded that the machine should be tried using governmental funding and asserted that the proposed means to move and steer the

[77] *Plan général des finances*. . ., op. cit., p. 4; SHD/DAT, 1 M 1161, #26 (Ventôse 14, Year 6/March 4, 1798); 6 W 66, dos. 6033(8), p. 3.

[78] *Plan général des finances*. . ., op. cit., p. 4.

[79] SHD/DAT, 1 M 1161, #23 (Pluviôse 27, Year 6/Feb. 15, 1798), #26 (Ventôse 14, Year 6/March 4, 1798).

[80] Jean Mascart, *La vie et les travaux du chevalier Jean-Charles de Borda (1733–1799). Épisodes de la vie scientifique au XVIII^e siècle* (1919), 2nd ed. Paris, Presses de l'université de Paris-Sorbonne (Bibliothèque de la revue d'histoire maritime), 2000.

[81] SHD/DAT, 1 M 1161, #23 (Pluviôse 27, Year 6/Feb. 15, 1798).

[82] *Ibid.* and #26 (Ventôse 14, Year 6/March 4, 1798).

balloon were "suitable for fulfilling their object".[83] After Borda's comments, it is doubtful that a positive report would have received his agreement: this could explain why Campmas claimed that Borda had not read the report. Bonaparte and Borda now being off the committee, and Fourcroy's expertise being mainly chemical, Le Roy was probably the reporter – he who had first supported Marat's works before retracting his recommendation.[84] On March 4, Campmas wrote to Milet-Mureau, the new Minister of War. He argued that the members of the Academy, who had all, excepting only Meusnier, rejected aerial navigation, would adopt his balloon only once it had actually returned from London.[85] Milet-Mureau responded that he had put the same group in charge of discussing Campmas' means of carrying out his plans with the inventor.[86] The project then spent two years moving from one minister to another, and from one commission to another.

Bonaparte's coup d'état changed the context. On January 25, 1800, General Berthier, the new Minister of War, put the Central Committee of Fortifications in charge of assessing the project, and the committee named General Chasseloup and Prieur reporters.[87] Four weeks later, Campmas was heard by the committee about his "aerial vessel intended to fight the fleet of England". As usual he refused to give any information, "saying that he was reserving the knowledge of the art processes as his own particular property",[88] and before any definitive decision, he asked for a provisional indemnity, proportionate to the sacrifices he had made for sixteen years to improve his machine, costs that he estimated at 25,000£. He further claimed that the various means he proposed for piloting balloons would be tried and that the best one would then be subjected to further tests. Therefore considering that the documents gave too vague and incomplete descriptions, the committee understandably refused on May 26 support the proposed experiments without further technical information. Since the inventor's works had not been demanded by the War department and had been of no use to it, the reporters judged that the requested indemnity depended on the Minister of the Interior, as "objects of arts and industry".[89]

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[83] Public auction, Collection Chavaillon, #324, December 2–3, 2005, Bordeaux. I had seen only the first and last pages of this document.

[84] In addition to Gillispie, *Science and Polity in France at the End of the Old Regime*. Princeton, Princeton University Press, 1980, pp. 305–306, see Olivier Coquard, *Jean-Paul Marat*. Paris, Fayard, 1993; Jean Bernard, Jean-François Lemaire, Jean-Pierre Poirier eds., *Marat homme de science?*, Paris, Les Empêcheurs de tourner en rond, 1993, that includes an « Intervention du professeur Charles C. Gillispie », pp. 151–157.

[85] SHD/DAT, 1 M 1161, #26 (Ventôse 14, Year 6/March 4, 1798).

[86] SHD/DAT, 1 M 1161, #24 (Ventôse 19, Year 6/March 9, 1798).

[87] SHD/DAT, Génie, register Comité central des fortifications (CCF), Pluviôse 5, Year 8/Jan. 25, 1800, f° 133.

[88] SHD/DAT, Génie, CCF, Ventôse 2, Year 8/Feb. 21, 1800, f° 165.

[89] SHD/DAT, Génie, CCF, Prairial 6, Year 8/May 26, 1800, f° 290–291.

It is worth noting that at the same time that these last two proposals were made, another curious person, the attorney Charles Thilorier – whom we encountered above as one of Campmas' hydraulic competitors – proposed similar projects for attacking England. Campmas clearly belonged to a milieu of inventors, but his work on military matters reveals an unusual, concealed aspect to his particular inventiveness.

21.4 Steam Engine and Artillery in the Revolutionary Wars

The first mention of Campmas' interest in the military field was a gunpowder mill he claimed he had designed in the *Journal encyclopédique* in December 1781, followed by a steam boat and a steam carriage, both equipped with steam artillery, whose designs he presented to the Amboise authorities in August 1791. In these cases, his military inventions were listed among civilian ones.[90]

The context was quite different on August 15, 1792, when he offered ten military inventions to the Legislative Assembly. Accused of double-dealing, the monarchy had effectively collapsed, having fled the Tuileries palace to escape the furious crowd five days previously, France had been at war for nearly four months, and the Duke of Brunswick was close to invading the country with the formidable Prussian army and its Austrian ally. Since his return from Amboise, Campmas had shown himself to be in accord with revolutionary aims, and he received honors at the Assembly's meetings in July for a projected monument entitled the "Tree of Liberty".[91] He now proposed a large number of inventions for military manufacturing (steam-driven gun casting and boring, firearms factory), as well as new weapons (recoilless firearms, canister guns, muskets and pistols), mobile carriages (steam cart, steam oven and mills), and fortifications (mobile redoubts). The most ambitious was a "New portable arms factory with a novel steam engine (*pompe à feu*) for main power, the fuel of which would cost very little, because it would be used at the same time to heat, forge, anneal, pierce, file down, turn and polish pieces, thanks to secondary machines driven by the first one".[92]

The day following Campmas' proposal, the Assembly forwarded his memoir to the Arms Committee (*Commission des armes*).[93] However, having received no answer after several months, the engineer withdrew his proposals on May 21, 1793, which was by then in the hands of the Arms Section (*Section des armes*) of the Committee of Public Safety of the new National Convention, which had

[90] *Journal encyclopédique*, Dec. 15, 1781, pp. 516–519; SHD/DAT, 6 W 66, dos. 6033(8), pp 3–5.

[91] James Guillaume, *Procès-verbaux du Comité d'Instruction publique de l'Assemblée législative*. Paris, Imprimerie nationale, 1889, p. 281.

[92] SHD/DAT, 6 W 66, dos. 6033(7), p. 2, item 10.

[93] For the organization of assessing inventions in the military field, see Bret, *L'Etat, l'armée, la science*. . ., op. cit.

proclaimed the French Republic the previous September. Campmas in any case confessed three years later that he had at the time possessed "no other knowledge in artillery than that inspired by the natural language of reason and the will to be useful to my motherland".[94] He then proposed to the same committee to convert a steam engine he was building on his own for "another public utility use" into a piercing machine, which would be able to produce 48,000 musket guns per year. However, the delays of the bureaucratic treatment of the affair were so long that the Paris Manufacture of portable arms ceased its own activity before his proposal was set up.[95]

In addition to steam engineering, Campmas continued work in a field for which he did have practical knowledge, namely hydraulics. In May, 1794, the war effort was at its zenith. Referring to his success at the Amboise manufacture and his award from the Consultative Board, he proposed to the Convention to convert the Marly machine into an arms factory, and after the peace into "the most brilliant factory in the whole world, for metals suitable for all the arts". Lazare Carnot, who was chairing the assembly, applauded and offered Campmas the meeting's honors, while the project was forwarded to the Committee of Alienations, then to the Provisional Commission of Arts (*Commission temporaire des arts*), where it was entrusted to the mechanical section of *Ponts et chaussées*. In July, Campmas sought an answer concerning the military part of his proposal. As we have seen above, Prony and Molard had considered only the mechanical part of the Marly machine in their report, having ignored the arms factory project, the one to which the inventor referred six years later when he published similar projects for the *Salpêtrière* and the *Ecole militaire*.[96]

New artillery carriages Campmas designed met a better reception. Two months earlier, on March 21, the revolutionary authorities of his district (*section de la Cité*) sent a deputation to the National Convention, offering to it thirteen models that the engineer had designed and built, including nine artillery carriages (for land and naval service) – in addition to two light ambulances and two pikes, the latter symbolically representing the *sans-culottes*' valor. These were forwarded to the War Committee, to which the inventor hastened to write.[97] Then, ten days after a positive report was issued by the *Jury des armes et inventions de guerre*, signed by the mining engineer Alexandre Miché as secretary, the military engineer and principal in charge of arms production, Prieur de la Côte-d'Or, proposed, and the Committee of Public Safety accepted on June 14, that Campmas should test his "flying artillery" two-wheel carriage

[94] SHD/DAT, 6 W 66, dos. 6033(8), p. 1.

[95] *Ibid.*, p. 3.

[96] *Réimpression de l'ancien Moniteur*, vol. 20, Paris, Bureau central, 1841, pp. 525–526 (Floréal 30, Year II/May 19, 1794); Louis Tuetey, *Procès-verbaux de la Commission temporaire des arts*. Vol. I, Paris, 1912, pp. 211–212 (Prairial 15/June 3), 275 (Messidor 20/July 8).

[97] SHD/DAT, 6 W 66, dos. 6033(7).

for a 4-pounder gun, which was the lightest caliber among the French ordnance.[98] This was in fact done at Vincennes on July 25. Generals Favereau and Drouas, director and deputy director of the Paris Arsenal, favorably wrote one week later of "the genius and the intelligence that had directed the fabrication of [Campmas'] field carriage", asking to have it tested at least on the field of the *École de Mars*, in the Paris suburbs, until the end of the campaign the following Fall.[99]

Artillery officers, military engineers and several inventors from the Consultative Board, the *Jury des armes*, and the *Lycée des arts* also attended those trials at Vincennes, notably Targe, president of the *Lycée*, Detrouville, Dumas, and Desaudray, members of both the Board and the *Lycée*. An improved version of the full size carriage, now including a fountain for watering the cannon, was subsequently exhibited in the centre of the main hall of the *Lycée des arts*, in the gardens of the Palais Royal. At its general assembly of November 30, in view of the far cheaper price of Campmas' carriage (500£ vs. 2 to 3,000 for a regular field carriage) and the great advantages in its construction and mobility, the *Lycée des arts* awarded Campmas honorable mention and a medal bearing a crown. It also decided to send copies of the report by the above mentioned members to the committees of the National Convention. . . .[100]

Despite these positive evaluations and recommendations, the inventor faced a bureaucracy which resulted in his proposals being "endlessly forwarded from one office to another by second rank agents". Two years later, on October 3, 1796, Campmas once again took up his the pen and wrote to the Minister of War, claiming that he had spent the equivalent of more than 50,000£ in gold on the military inventions alone, and had now to sell them at a cheap price "in order to be able to survive". He also sent abstracts of his previous proposals to the Legislative Assembly and National Convention and copies of the reports that had been issued concerning them. Finally, on November 17 the minister Petiet asked the Central Committee of the Artillery to send a report about these military proposals, which Generals Aboville, Fabre de La Martillière and Drouas soon wrote.

The worst military crisis of the 1790s was now past, and the treasury was empty, while the innovative actions taken in the Revolutionary Year II were regressing: the Consultative Board had closed in spring, as had the research center for secret weapons created at Meudon in Fall 1793, while the twin center on military ballooning was now attacked, both at the legislative assemblies, like the *École polytechnique*, and by the Generals, especially since the balloon and aeronautic gear of the Rhine Army had been taken by the Austrians at Würzburg in September, when Jourdan retreated.[101] Given all of this,

[98] *Ibid.*, Titre 3, p. 5 (Prairial 16, Year II/June 4, 1794); AN, AF II 220, #2 (Prairial 26/June 14).

[99] *Ibid.*, Titre 4, pp. 5–7. The *École de Mars* was a revolutionary training school for soldiers.

[100] *Ibid.*, Titre 5, pp. 8–11.

[101] Emmanuel Grison, "Les premières attaques contre l'Ecole polytechnique (1796–1799). La défense de l'École par Prieur de la Côte-d'Or et Guyton de Morveau", *Bulletin de la Société des amis de la bibliothèque de l'Ecole polytechnique (SABIX),* 8 (Dec. 1991), 1–24; P. Bret,

Campmas' praised field carriage was neither adopted nor further tested, but rejected by the Committee. However, the inventor was still encouraged by the opinion of the "three Generals learned in the science of machines" concerning his steam carriage and gun: "New fire-powered carts to facilitate the hauling of artillery gear and war munitions. It can also shoot bullets without powder".[102]

To Campmas' new memoir, on November 23, 1796, a table titled "The propagation of fire, or the Twelve Sisters" was added. It contained drawings and descriptions of various steam engines, together with the minutes of the visit of his collection of models at Amboise by fourteen administrators of the district and town, which had taken place as early as August 18, 1791:[103]

> The first, called *La Division*, the model of which M. Campmas showed us, is intended to saw (reffendre) big pieces in the forests by the action of fire so as to make beams, ribs and planks, and to carry them out of the woods.
>
> The second, called *La Générale*, the model of which we have also seen, is intended to replace by the action of fire all the machines run by streams of water.
>
> The third, called *L'Orageuse* (The Thundery), the model of which we have also seen, is intended to run by fire all the machines necessary in metals manufacturing.
>
> The fourth called *L'Amazone* is a steam carriage intended to run without the assistance of horses.
>
> The fifth, called *La Baleine* (The Whale) is intended to sail ships by the action of fire and without the assistance of wind; to provide them with drinking water; to pump out water if necessary; to renew the air; and to shoot bullets without gunpowder.
>
> The sixth, called *L'Abeille* (The Bee), is intended to have boats sailing upstream, and to pilot some aerial vessels that this engineer promises to let soon be known.[104]
>
> The seventh called *Le Bon Patriote* (The Good Patriot) is a novel, fire-powered hammer that could be said universal, because it could be set up in all the countries around the world next to an oven, and the fuel burnt [by that oven] will be sufficient to run it.
>
> The eighth, called *La Révolution*, is a novel, cheap means to run by continuous fire of the ironworks all the machines necessary to their exploitation, and to bore guns without any water stream or special fuel.
>
> The ninth called *L'Abondance* (the Abundance) is a new, fire-powered cart intended for plowing and for every kind of haulage, even for shooting bullets without gunpowder, thanks to secondary means.
>
> The tenth called *La Française* (the French) is a new and simple fire pump, without any apparent pendulum or injector. M. Campmas showed us a model conformable to the drawing.
>
> The eleventh called *L'Aube* (the Dawn), is a steam engine (*machine à feu*) without any piston. The author dedicates it to the memory of the famous Papin, who was the first to think of pumping water by means of fire. The author proposes to use it for the

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"Recherche scientifique, innovation technique et conception tactique d'une arme nouvelle: l'aérostation militaire (1793–1799)", in Jean-Paul Charnay ed., *Lazare Carnot ou le Savant-citoyen*, Paris, Presses de l'Université de Paris-Sorbonne, 1990, pp. 429–451.

[102] SHD/DAT, 6 W 66, dos. 6033(8), p. 6. The steam cart was Item 8 in August 1792 (dos. 6033(7), p. 2).

[103] SHD/DAT, 6 W 66, dos. 6033(8), p. 5.

[104] This item was developed in the above mentioned "Treatise on Ballooning" (cf. footnote 76).

> maintenance of new seaports and ship canals that he has invented. We have also seen the arrangement of a model he had used.
>
> Finally, the twelfth, named *La Balance* (the Scale) is a novel, double-effect steam engine (*pompe à feu*), simpler and less expensive than English machines. Its purpose is to raise water to any required level.

Did these engines actually work? Gitton, the vice-president of the district of Amboise, and his son Sylvain testified that Campmas had brought a model of *L'Orageuse* to Paris in May 1789, in order to have it made in full size, at a time when France was mainly concerned with the opening of the *États généraux*. That model was eventually made more powerful and faster in operation later, thanks to an alembic, what had not been used at first. All the local authorities who visited him at Amboise in August 1791 were granted a demonstration:

> Soon after the fire came into action, M. Campmas simply turned the key of a small tap on the top of the machine. Immediately, the latter began a very fast rotary movement that made the hammer stamp. We are not able to calculate its speed. But the author was able to moderate the action as he pleased by the means of the key of the same tap, by turning it to a lesser or greater extent. We noticed that the machine kept working as long as the fire was active.[105]

In November 1796, Campmas proposed to build for military haulage a full size steam carriage based on his ninth device, called *L'Abondance* because it was originally designed for plowing, this being the one first proposed to the Legislative Assembly four years earlier. He required 12,000£ to build it, for which he offered all his present and future belongings as collateral and asserted that, although four months would suffice to build it, the carriage should be delivered only after a two hundred-league experimental journey on roads. He promised further advantages: a crew of only two men (one for fuel, one for steering), obviously no need to feed horses even when they are not working, very low costs, etc. He asked as well support in the amount of 6,000£ to build full size models of his field carriages for 4, 8 and 12-pounder guns in order to field-test them.[106]

Although Generals Aboville, Fabre de La Martillière and Drouas again rejected both of Campmas' proposals three weeks later, they did propose to grant him 1,340£, i.e. the cost of a regular 24-pounder carriage, seen as a fair indemnity for his construction of the "flying artillery" carriage,

> 1° because his patriotism has led him to turn his inventive genius to objects that he thought the most useful to the Republic
>
> 2° because he has built his carriage at his own expense, and did that only following an order of the Committee of Public Safety on Prairial 26, Year 2nd [June 14, 1794].[107]

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[105] Ibid., pp. 3–4.

[106] Ibid., p. 6. In February 1798, Campmas gave a note on his field carriages to the National Institute, that was read and sealed on March 1 (*PVAS* I, p. 353).

[107] SHD/DAT, 6 W 66, dos. 6033(9), Frimaire 26, Year 5 (Dec 16, 1796). See also 6 W 65 and 6 W 75.

Even though the context was not propitious for developing inventions, the above reporters remained open to innovations. General Aboville himself, the president of the Central Committee of the Artillery, often proved his continuing interest in such things.[108] At Campmas' workshop, they had visited the collection of military machines which he had invented, including carriages, guns, and a caisson ambulance, and remarked that all of them should be purchased by the government, since many contained in their smallest details ideas that could be of profit to artillerists in charge of improving ordnance. They were especially impressed by Campmas' new proposal: "a steam engine (*machine à feu*), the power and the robustness of which will be such that it will be easy to carry on the main roads ten thousand pounds with a speed of two leagues per hour; its daily consumption of coal will not exceed 600 pounds. Therefore, the cost will be only 20 francs for carrying 10 thousand on 48 leagues, what is less than one penny (*denier*) per pound". More generally, the experts of the Artillery appreciated his other major inventions in the field:

> It seems to us, that [Campmas' inventions] must lead to most useful things. There are applications of the steam engine (*machine à feu*), which has been too neglected as a means for replacing everywhere the raising forces that Nature does not everywhere nor every time supply. The assistance of fire is very powerful and less expensive than that of horses. The extreme complication of those first machines has probably delayed the progress of this precious invention. But it is only by repeating and multiplying attempts, that we shall reach that greater simplicity which most machines acquire only over time. Citizen Campmas seemed to us have made a few steps forward for those machines of which we speak. He showed us the designs of a great number of the applications which he had envisioned, including one for replacing horses for hauling. We know that this test has already been done.[109] Even should Citizen Campmas' efforts prove fruitless, he nevertheless deserves the gratefulness of the government: he will have smoothed the path by which another will succeed. Therefore, we think that Citizen Campmas' works for improving steam engines and their various applications are worth being encouraged.[110]

Three days later, General Milet-Mureau, on behalf of the minister (Petiet) made an offer to the inventor. Agreeing to sell his artillery models, Campmas suggested that he should add their plans too, which had been at the Consultative Board, then the National Institute for the past fifteen months.[111] He also asked for an advance of 900£ to execute a full size model of his three-horse ambulance which could carry some twenty people, with couchettes for the most wounded.

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[108] He defended Fabre's shells (*boulets creux*), and was later himself an inventor. Charles Gillispie, "Science and secret weapons development in Revolutionary France, 1792–1804: A documentary history", *Historical Studies in Physical Sciences*, 23:1 (1992), 35–152; Bret, *L'Etat, l'armée, la science*..., op. cit., pp. 310–312, 346.

[109] Reference to Cugnot's experiments around 1770.

[110] SHD/DAT, 6 W 66, dos. 6033(9).

[111] Lastly, on February 19, he presented a memoir on a new construction for field carriages and a new shape of gun to the president of the first class of the National Institute, that was read at the next meeting (Feb. 24), then sealed on March 1. *PVAS* I, 353.

Finally, he said he would sell the military carriages only after receiving a patent (*brevet d'invention*).[112]

On January 5, 1797, Petiet urged the Central Committee of the Artillery to speak with Campmas about his steam-driven hauler. Encouraging private research and funding its development are not the same, particularly in a time of budgetary restrictions. The negotiations failed, since Campmas wanted "to keep, as his secret and property, the means he uses", as duly recorded by the still innovation-minded members of the committee (Aboville, Pommereul, Lariboisière, Villantroys), who delivered further, severe conclusions on February 1. The 12,000 £ asked by Campmas to build his carriages and to prove the feasibility of his proposals were judged to be highly exaggerated. Moreover, steam carriages had never proved their efficiency, and even though they might succeed on the roads, they could not be used in artillery movements on the field, and could therefore not replace horse carriages. Consequently the inventor was invited to "to turn his aims and applications toward commercial haulage, which will always present him with more assured awards than those the government can offer."[113]

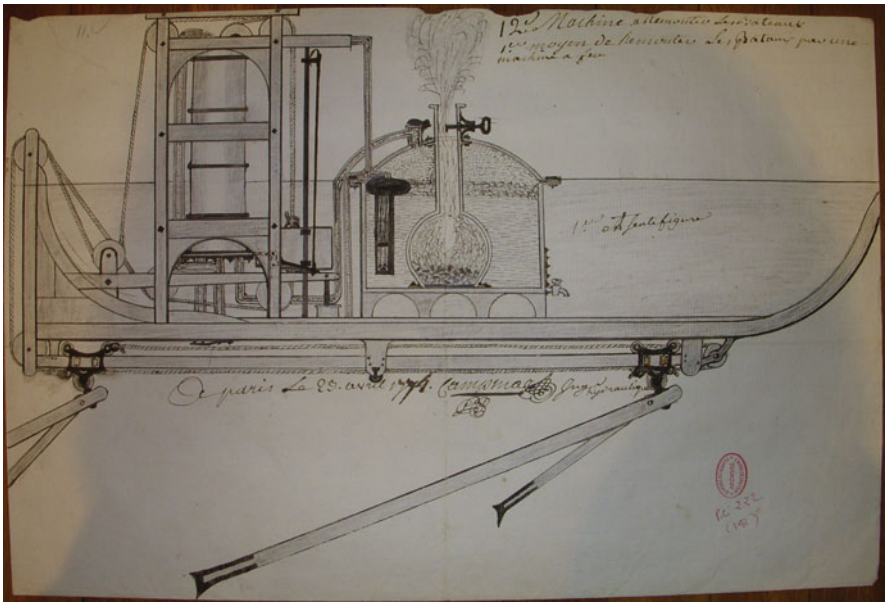

Fig. 21.6 "12th machine for towing boats, 1st means for towing boats with a steam engine", Paris, Apr. 23, 1774 (AAdS, *pochette*, Dec. 7, 1782). Fanciful punting with mechanical legs, which preceded Campmas' mobile cogwheel could use several sorts of power. Courtesy of the Academy of Sciences, Paris

[112] SHD/DAT, 6 W 66, dos. 6033(10) (Nivôse 4, Year 5/Dec. 24, 1796).

[113] SHD/DAT, 6 W 66, dos. 6033(11) (Pluviôse 13, Year 5/Feb. 1, 1797).

Several inventors and entrepreneurs dealt with the steam engine in France, including major ones like the Perier brothers or the Spanish engineer Betancourt, who did have some industrial success, or Cugnot, Jouffroy d'Abbans, Robert Fulton and Charles Dallery who succeeded with machines for mobility. But none proposed such a huge range of applications as Campmas. For decades he conceived many applications of the steam engine, both as fixed devices in arms factories and at the Mint, and in mobile devices, from his very first project of a legged steam tugboat in 1774 (see Fig. 21.6) to his carriages for hauling, which were definitively rejected in 1797. There was even the last work that he presented to the National Institute on December 5, 1803, for which he asked only a dated certificate: "New naval and continental artillery, proved by twenty-three drawn figures and accompanied by manuscript details", which probably included steam-powered carriages and boats and steam guns, as in Campmas' previous inventions.[114] For him, who was never able to build a full size version of his designs, the steam engine was a kind of universal power source adaptable to any and every mechanical purpose.

21.5 Conclusion

In November 1796, Campmas decried what he saw as inconstant governmental decisions concerning the inventions that he had proposed and even constructed over "twenty three years (...) in Paris and in the departments, with money, sometimes from companies and sometimes from ordinary persons who trusted me". He bitterly constructed a story of bitter rejection, the story of an inventor harassed by the experts of administration and scientific institutions:[115]

> Twenty six years of my live have been spent in useless proposals that I made to the government. I say useless, because, people more skilled than me in dealing with the government have been able to profit from the proposals I started, and from the far too long delays of the reports required by my applications; they have been able, I say, to bury my work, while they had their own, useless projects adopted, which only caused the ruin of the Nation. As evidence of my assertion, I can cite the enormous amount of quite expensive machines set up for portable firearms, machines that were eventually destroyed.

Complicated, repetitive and tedious though Campmas' story maybe, it deserves to be known in detail, as a way to look inside the black box of invention and assessment, to visualize and measure the tremendous work required from ordinary inventors to gain credit, as well as their need to work within existing and to forge a new social network, in both the previous aristocratic as well as the new revolutionary contexts – as nicely exemplified by the societies of inventors. Campmas deployed about twenty different direct and indirect ways to have his

[114] *PVAS* III, pp. 29–30 (Frimaire 13, Year 12).

[115] SHD/DAT, 6 W 66, dos. 6033(8), p. 6.

works approved and to generate support from many different kinds of institutions – a dozen members of the Royal Academy being the better known public ones, followed by the more than thirty civilian and military experts who assessed his inventions. There were also private sources to be sought, sources that he hoped to activate by means of announcements in journals and through the sale of his engravings. The only source that he never used was the new system of patents that the societies of inventors obtained in January 1791,[116] for it appeared to him to be too expensive and insufficiently protective, unlike the sealed envelopes of the Academy.

This case study illuminates, on the one hand, the increasing bitterness of the rejected inventors towards the Academy and the bureaucracy; and, on the other hand, the increasing irritation of the experts, who could not carry out their tasks without full information concerning the proposed inventions, information that the inventors were reluctant to yield for fear of losing control. This was the major stumbling block between those who were in charge of assessing invention and the numerous frustrated inventors, many of whom – like Campmas – eventually joined the societies of inventors during the Revolution. The gap grew ever wider between inventors to one side and the savants and even the military experts to the other. The latter two groups argued for an open science and technology, while many inventors who thought secrecy to be their best protection. Nevertheless, Campmas, like many inventors, did benefit to some extent from the Revolution, thanks to new institutions and the growing presence for the first time of non-academic experts. The academicians of the Consultative Board of arts and crafts – half of the members – and the *Lycée des arts* remained uninvolved when the institutions to which they belonged strongly supported Campmas: the reporters for the Amboise machinery at the Board and for his artillery models at the *Lycée*, for example, were all members of the *Société du Point Central*, like Campmas himself.

His too short or too long but still vague memoirs often palmed off old projects with small corrections. His desperate applications, his bitter claims and plaintive logorrhea are similar to those of many other inventors, who jealously guarded their inventions, and who were quick to challenge their judges, to claim priority and to charge their competitors with theft. Their bothersome behavior repulsed the experts, who could not correctly assess proposals on the basis of insufficient data. Nuisance to the experts their behavior may have been, it often saved the inventor from failure. Most likely they would often have failed since they lacked appropriate knowledge for the elaborate devices that they had in mind. But these failures themselves might have led

[116] See Gabriel Galvez-Behar. *La République des inventeurs: Propriété et organisation de l'innovation en France (1791–1922)*. Rennes, Presses Universitaires de Rennes, 2008; Christiane Demeulenaere-Douyère, "Les pétitions et le vote des lois protectrices de l'invention en 1791", in *L'individu face au pouvoir: les pétitions aux assemblées parlementaires, Revue administrative*, special issue 2008, pp. 61–69; id., "Inventeurs en Révolution: la Société des inventions et découvertes", *Documents pour l'histoire des techniques*, 17 (2009), pp. 19–56.

to further improvements and cumulative technological progress. Campmas clearly lacked scientific knowledge, and so he was not able to compete successfully with increasingly better-trained engineers. Still, though he nearly always failed to have his inventions developed, there was the exception of his participation in a major hydraulic operation for an importantly-innovative industrial project supported by the government, namely the one at Amboise. Whatever the actual feasibility and reliability of his devices may have been, it is worth noting the visionary spirit of his proposals, especially regarding steam engines. His drafts of these sorts of inventions deserve to be known, not because he was a precursor of later developments – that would be nonsense – but to emphasize the particular quality of his inventiveness in an unusually inventive context, that was encouraged and intensified by the government in wartime. Campmas' vision of one and the same device for both plowing and cannoneering was in a sense realized in the twentieth century through the famous T-34 Soviet tank, which was designed at the Stalingrad tractor plant.[117]

Braggadocio and reality mix together in the proposals of these fertile minded but paranoiac inventors, and it is often difficult to sort truth from half-lies and outright falsehood. Yet Campmas was not a faker, and he did have some expertise, enough to achieve the occasional, if rare, success, at the two opposite sides of the process of technological invention, namely in his first general idea of a novel device for a new application, which could seem fanciful to others, and in his micro-innovation of details, i.e. in the design of minor, but sometimes crucial, improvements. Unlike Conté with his balloons at Meudon and other achievements in Egypt, and unlike many other inventors who also belonged to the scientific milieu, Campmas never accepted that he ought to work in an open world. Unlike Captain Fabre and his secret weapons at Meudon, carefully studied by Charles Gillispie,[118] Campmas never joined alliance between the military and scientific worlds of the Year II. His story bears witness to the difficulties faced by an ordinary inventor in France at the end of the Old Regime and in the Revolutionary and early Napoleonic years.

Acknowledgement I am grateful to Jed Buchwald for his careful editing and polishing my text, and to Florence Greffe, Claudine Pouret, Marie Thebaud-Sorger and Christiane Demeulenaere-Douyère for their kind help.

[117] Yves Cohen, « Technique et politique : une histoire réciproque (France et Union soviétique entre les deux guerres), in *Artisans, industrie. Nouvelles révolutions du Moyen Âge à nos jours*, eds. Natacha Coquery, Liliane Hilaire-Pérez, Line Sallmann and Catherine Verna, Lyon, ENS Editions – SFHST, 2004, 227–236 (p. 235). The anti-Bolshevik writer Jean M. Rivière prophesized that "the inoffensive tractors that serve as agricultural machines at peace can easily be transformed into gun tractors or tanks at war" (*L'URSS dans le monde: l'expansion soviétique de 1918 à 1935*, Paris, Payot, 1935).

[118] Gillispie, "Science and secret weapons development...", op. cit.